

CLAIMS

1. A video predictive encoding device comprising:

input means that inputs a plurality of pictures constituting a video sequence;

5 encoding means which encodes the pictures by either intra-frame prediction or inter-frame prediction to generate compressed picture data, and which also encodes output order information of each picture and information about a picture type of each picture, the compressed picture data generated to include a picture serving as a
10 random access point;

reconstruction means which decodes the compressed picture data to reconstruct pictures;

picture storage means which stores one or more of the reconstructed pictures as reference pictures to be used for encoding of a
15 subsequent picture; and

control means which determines the picture type and controls the picture storage means, based on the determination of the picture type,

wherein the control means labels each of the pictures as one of
20 three types:

1) a clean random access (CRA) picture, the CRA picture being a picture which is characterized in that a type 2 picture, subsequent to a CRA picture, can be correctly decoded when decoding is started from the CRA picture;

25 2) a type 1 picture, the type 1 picture being a picture which is decoded after a CRA picture associated with the picture and is

outputted before the associated CRA picture, and which has a list of reference pictures for execution of inter-frame prediction, the list of reference pictures including at least one reference picture labeled as a type 1 picture or at least one reference picture preceding said associated CRA picture in decoding order;

3) a type 2 picture, the type 2 picture being a picture which has a list of reference pictures for execution of inter-frame prediction, and which is characterized in that every reference picture in the list of reference pictures is labeled as either a type 2 picture or a CRA picture and is decoded after a CRA picture associated with the picture.

2. A video predictive encoding device comprising:

input means that inputs a plurality of pictures constituting a video sequence;

encoding means which encodes the pictures by either intra-frame prediction or inter-frame prediction to generate compressed picture data and which also encodes output order information of each picture, the compressed picture data including a picture serving as a random access point;

reconstruction means which decodes the compressed picture data to reconstruct pictures;

picture storage means which stores one or more of the reconstructed pictures as reference pictures to be used for encoding of a subsequent picture; and

control means which controls the picture storage means, and

which classifies and controls each of the pictures, the pictures classified into three types:

1) a clean random access (CRA) picture from which decoding of encoded data is started;

5 2) a picture, which is decoded after a CRA picture associated with the picture, which is outputted before the associated CRA picture, which is not subjected to a decoding process by the reconstruction means and is not stored in the picture storage means or output, and which has a list of reference pictures for execution of inter-frame
10 prediction, the list of reference pictures including at least one reference picture not subjected to the decoding process by the reconstruction means, or at least one reference picture preceding the associated CRA picture in decoding order;

15 3) a picture which is decoded by the reconstruction means and stored in the picture storage means for reference as needed, and which is characterized in that the picture has a list of reference pictures for execution of inter-frame prediction and in that every reference picture in the list of reference pictures is decoded by the reconstruction means and is decoded after a CRA picture associated with the picture.

20 3. A video predictive encoding method executed by a video predictive encoding device, comprising:

an input step of inputting a plurality of pictures constituting a video sequence;

25 an encoding step of encoding the pictures by either intra-frame prediction or inter-frame prediction to generate compressed picture

data and also encoding output order information of each picture and information about a picture type of each picture, the picture data including a picture serving as a random access point;

5 a reconstruction step of decoding the compressed picture data to reconstruct pictures;

a picture storage step of storing one or more of the reconstructed pictures as reference pictures to be used for encoding of a subsequent picture; and

10 a control step of determining the picture type and controlling the picture storage step based on the determined picture type,

wherein the control step further comprises the video predictive encoding device labeling each of the pictures as one of three types:

15 1) a clean random access (CRA) picture, the CRA picture being a picture which is characterized in that a type 2 picture, subsequent to a CRA picture, can be correctly decoded when decoding is started from the CRA picture;

20 2) a type 1 picture, the type 1 picture being a picture which is decoded after a CRA picture associated with the picture and is outputted before the associated CRA picture, and which has a list of reference pictures for execution of inter-frame prediction, the list of reference pictures including at least one reference picture labeled as a type 1 picture, or at least one reference picture preceding said associated CRA picture in decoding order;

25 3) a type 2 picture, the type 2 picture being a picture which has a list of reference pictures for execution of inter-frame prediction, and which is characterized in that every reference picture in the list of

reference pictures is labeled as a type 2 picture or as a CRA picture and is decoded after the associated CRA picture.

4. A video predictive encoding method executed by a video predictive encoding device, comprising:

an input step of inputting a plurality of pictures constituting a video sequence;

an encoding step of encoding the pictures by either intra-frame prediction or inter-frame prediction to generate compressed picture data and encoding output order information of each picture, the compressed picture data including a picture serving as a random access point;

a reconstruction step of decoding the compressed picture data to reconstruct pictures;

a picture storage step of storing one or more of the reconstructed pictures as reference pictures to be used for encoding of a subsequent picture; and

a control step of controlling the picture storage step,

wherein in the control step the video predictive encoding device classifying and controlling each of the pictures, the pictures classified into three types:

1) a clean random access (CRA) picture from which decoding of encoded data is started;

2) a picture, which is decoded after a CRA picture associated with the picture and is outputted before the associated CRA picture, is not subjected to a decoding process by the reconstruction step and

which is not stored in the picture storage step or output, and which has a list of reference pictures for execution of inter-frame prediction, the list of reference pictures including at least one reference picture not subjected to the decoding process by the reconstruction step , or at least one reference picture preceding the associated CRA picture in decoding order;

3) a picture which is decoded by the reconstruction step and stored in the picture storage step for reference as needed, and which is characterized in that the picture has a list of reference pictures for execution of inter-frame prediction, and every reference picture in the list of reference pictures is decoded by the reconstruction step and decoded after the associated CRA picture.

5. A video predictive encoding program for letting a computer function as:

input means that inputs a plurality of pictures constituting a video sequence;

encoding means which encodes the pictures by either intra-frame prediction or inter-frame prediction to generate compressed picture data including a picture serving as a random access point and the encoding means also encodes output order information of each picture and information about a picture type of each picture;

reconstruction means which decodes the compressed picture data to reconstruct pictures;

picture storage means which stores one or more of the reconstructed pictures as reference pictures to be used for encoding of a

subsequent picture; and

control means which determines the picture type and controls
the picture storage means based on the determined picture type,

wherein the control means labels each of the pictures as one of:

5 1) a clean random access (CRA) picture: the CRA picture being
a picture which is characterized in that a type 2 picture subsequent to a
CRA picture can be correctly decoded when decoding is started from
the CRA picture;

10 2) a type 1 picture: the type 1 picture being a picture which is
decoded after a CRA picture associated with the picture and is
outputted before the associated CRA picture, and which has a list of
reference pictures for execution of inter-frame prediction, the list of
reference pictures including at least one reference picture labeled as a
type 1 picture or at least one reference picture preceding said associated
15 CRA picture in decoding order;

 3) a type 2 picture: the type 2 picture being a picture which has
a list of reference pictures, for execution of inter-frame prediction, and
which is characterized in that every reference picture in the list of
reference pictures is labeled as either a type 2 picture or a CRA picture
20 and is decoded after a CRA picture associated with the picture.

6. A video predictive encoding program for letting a computer
function as:

25 input means that inputs a plurality of pictures constituting a
video sequence;

 encoding means which encodes the pictures by either

intra-frame prediction or inter-frame prediction to generate compressed picture data and which also encodes output order information of each picture, the compressed picture data including a picture serving as a random access point;

5 reconstruction means which decodes the compressed picture data to reconstruct pictures;

picture storage means which stores one or more of the reconstructed pictures as reference pictures to be used for encoding of a subsequent picture; and

10 control means which controls the picture storage means, wherein the control means classifies and controls each of the pictures into three types:

1) a clean random access (CRA) picture from which decoding of encoded data is started;

15 2) a picture, which is decoded after a CRA picture associated with the picture, and is outputted before the associated CRA picture, which is not subjected to a decoding process by the reconstruction means and is not stored in the picture storage means or output, and which has a list of reference pictures for execution of inter-frame
20 prediction, the list of reference pictures including at least one reference picture not subjected to the decoding process by the reconstruction means, or at least one reference picture preceding the associated CRA picture in decoding order;

25 3) a picture which is decoded by the reconstruction means and is stored in the picture storage means for reference as needed, and which is characterized in that the picture has a list of reference pictures

for execution of inter-frame prediction and in that every reference picture in the list of reference pictures is decoded by the reconstruction means and is decoded after a CRA picture associated with the picture.

5 7. A video predictive decoding device comprising:

input means that inputs, for a plurality of pictures constituting a video sequence, compressed picture data including a random access picture, encoded data indicative of an output order of each picture, and a picture type of each picture resulting from encoding by either
10 intra-frame prediction or inter-frame prediction;

reconstruction means which decodes the compressed picture data and the encoded data to reconstruct pictures, output order information, and output picture type information;

picture storage means which stores one or more of said
15 reconstructed pictures as reference pictures to be used for decoding of a subsequent picture; and

control means which controls the reconstruction means, based on the picture type,

wherein each picture is labeled with the picture type, and the
20 picture type being one of three types :

1) a clean random access (CRA) picture, the CRA picture being a picture which is characterized in that a type 2 picture subsequent to a CRA picture, can be correctly decoded when decoding is started from the CRA picture;

25 2) a type 1 picture, the type 1 picture being a picture which is decoded after a CRA picture associated with the picture and is

outputted before the associated CRA picture, and which has a list of reference pictures for execution of inter-frame prediction, the list of reference pictures including at least one reference picture labeled as a type 1 picture, or at least one reference picture preceding said associated CRA picture in decoding order;

3) a type 2 picture, the type 2 picture being a picture which has a list of reference pictures for execution of inter-frame prediction, and which is characterized in that every reference picture in the list of reference pictures is labeled as a type 2 picture or as a CRA picture and is decoded after an the associated CRA picture; and

wherein the reconstruction means continues a decoding process during a period immediately before processing a next CRA picture, the decoding process continued such that when decoding of encoded data is started from a CRA picture, the reconstruction means decodes a picture labeled as a type 2 picture and skips decoding of a picture labeled as a type 1 picture.

8. A video predictive decoding device comprising:

input means that inputs compressed picture data for a plurality of pictures constituting a video sequence, the compressed picture data including a random access picture and encoded data indicative of an output order of each picture, resulting from encoding by either intra-frame prediction or inter-frame prediction;

reconstruction means which decodes the compressed picture data and the encoded data to reconstruct pictures and output order information;

picture storage means which stores one or more of said reconstructed pictures as reference pictures to be used for decoding of a subsequent picture; and

control means which controls the reconstruction means,

5 wherein the control means classifies and controls each of the pictures, the pictures classified into three types:

1) a clean random access (CRA) picture from which decoding of encoded data is started;

10 2) a picture, which is decoded after a CRA picture associated with the picture, and is outputted before the associated CRA picture, which is not subjected to a decoding process by the reconstruction means and is not stored in the picture storage means or output, and which has a list of reference pictures for execution of inter-frame prediction, the reference pictures including at least one reference picture not subjected to the decoding process by the reconstruction
15 means, or at least one reference picture preceding the associated CRA picture in decoding order;

20 3) a picture which is decoded by the reconstruction means and stored in the picture storage means for reference as needed, and which is characterized in that the picture has a list of reference pictures for execution of inter-frame prediction and every reference picture in the list of reference pictures is decoded by the reconstruction means and is decoded after a CRA picture associated with the picture; and

25 wherein the reconstruction means continues a decoding process, during a period immediately before processing a next CRA picture, such that when decoding of encoded data is started from an associated

CRA picture, the reconstruction means decodes a target picture if every reference picture in a list of reference pictures for the target picture is stored in the picture storage means, and the reconstruction means skips decoding of the target picture if one or more reference pictures in the list of reference pictures are not stored in the picture storage means.

9. A video predictive decoding method executed by a video predictive decoding device, comprising:

an input step that inputs compressed picture data for a plurality of pictures constituting a video sequence, the compressed picture data including a random access picture and encoded data indicative of an output order of each picture and a picture type of each picture, resulting from encoding by either inter-frame prediction or intra-frame prediction;

a reconstruction step of decoding the compressed picture data and the encoded data to reconstruct pictures, output order information, and picture type information;

a picture storage step of storing one or more of said reconstructed pictures as reference pictures to be used for decoding of a subsequent picture; and

a control step of controlling the reconstruction step, based on the picture type,

wherein each picture is labeled with the picture type, and the picture type being one of three types:

1) a clean random access (CRA) picture, the CRA picture being a picture which is characterized in that a type 2 picture subsequent to a

CRA picture can be correctly decoded when decoding is started from the CRA picture;

5 2) a type 1 picture, the type 1 picture being a picture which is decoded after a CRA picture associated with the picture and is outputted before the associated CRA picture, and which has a list of reference pictures for execution of inter-frame prediction, the list of reference pictures including at least one reference picture labeled as a type 1 picture or at least one reference picture preceding said associated CRA picture in decoding order;

10 3) a type 2 picture, the type 2 picture being a picture which has a list of reference pictures for execution of inter-frame prediction, and which is characterized in that every reference picture in the list of reference pictures is labeled as either a type 2 picture or a CRA picture and is decoded after a CRA picture associated with the picture; and

15 wherein in the reconstruction step the video predictive decoding device continues a decoding process, during a period immediately before a process of a next CRA picture, the decoding process continued such that when decoding of encoded data is started from a CRA picture, the video predictive decoding device decodes a picture labeled as a
20 type 2 picture and skips decoding of a picture labeled as a type 1 picture.

10. A video predictive decoding method executed by a video predictive decoding device, comprising:

25 an input step of inputting compressed picture data for a plurality of pictures constituting a video sequence, the compressed picture data

including a random access picture and encoded data indicative of an output order of each picture, resulting from encoding by either intra-frame prediction or inter-frame prediction;

5 a reconstruction step of decoding the compressed picture data and the encoded data to reconstruct pictures and output order information;

a picture storage step of storing one or more of said reconstructed pictures as reference pictures to be used for decoding of a subsequent picture; and

10 a control step of controlling the reconstruction step comprising the video predictive decoding device classifying and controlling each of the pictures into three types:

1) a clean random access (CRA) picture from which decoding of encoded data is started;

15 2) a picture, which is decoded after a CRA picture associated with the picture, and is outputted before the associated CRA picture, which is not subjected to a decoding process by the reconstruction step and is not stored in the picture storage step or output, and which has a list of reference pictures for execution of inter-frame prediction, the list of reference pictures including at least one reference picture not
20 subjected to the decoding process by the reconstruction step, or at least one reference picture preceding the associated CRA picture in decoding order;

25 3) a picture which is decoded by the reconstruction step and stored in the picture storage step for reference as needed, and which is characterized in that the picture has a list of reference pictures for

execution of inter-frame prediction and in that every reference picture in the list of reference pictures is decoded by the reconstruction step and is decoded after a CRA picture associated with the picture;

wherein in the reconstruction step the video predictive decoding device continues a decoding process, during a period immediately before a process of a next CRA picture, the decoding process continued such that the video predictive decoding device determines whether every reference picture in a list of reference pictures for a target picture is stored in the picture storage step, in response to every reference picture in the list of reference pictures being stored, the video predictive decoding device decoding the target picture, and in response to one or more reference pictures in the list of reference pictures not being stored, the video predictive decoding device skips decoding of the target picture.

11. A video predictive decoding program for letting a computer function as:

input means which inputs compressed picture data for a plurality of pictures constituting a video sequence, the compressed picture data including a random access picture, encoded data indicative of an output order of each picture, and a picture type of each picture, resulting from encoding by either intra-frame prediction or inter-frame prediction;

reconstruction means which decodes the compressed picture data and the encoded data to reconstruct pictures, output order information, and picture type information;

picture storage means which stores one or more of said reconstructed pictures as reference pictures to be used for decoding of a subsequent picture; and

control means which controls the reconstruction means, based
5 on the picture type,

wherein each picture is labeled with the picture type, and the picture type is one of three types:

1) a clean random access (CRA) picture, the CRA picture being a picture which is characterized in that a type 2 picture subsequent to a
10 CRA picture, can be correctly decoded when decoding is started from the CRA picture;

2) a type 1 picture, the type 1 picture being a picture which is decoded after a CRA picture associated with the picture and is outputted before the associated CRA picture, and which has a list of
15 reference pictures for execution of inter-frame prediction, the list of reference pictures including at least one reference picture labeled as a type 1 picture, or at least one reference picture preceding said associated CRA picture in decoding order;

3) a type 2 picture, the type 2 picture being a picture which has
20 a list of reference pictures for execution of inter-frame prediction, and which is characterized in that every reference picture in the list of reference pictures is labeled as a type 2 picture or as a CRA picture and is decoded after the associated CRA picture; and

wherein the reconstruction means continues a decoding process,
25 during a period immediately before a process of a next CRA picture, the decoding process continued such that when decoding of encoded

data is started from a CRA picture, the reconstruction means decodes a picture labeled as a type 2 picture and skips decoding of a picture labeled as a type 1 picture.

5 12. A video predictive decoding program for letting a computer function as:

input means which inputs compressed picture data for a plurality of pictures constituting a video sequence, the compressed picture data including a random access picture and encoded data
10 indicative of an output order of each picture, resulting from encoding by either intra-frame prediction or inter-frame prediction;

reconstruction means which decodes the compressed picture data and the encoded data to reconstruct pictures and output order information;

15 picture storage means which stores one or more of said reconstructed pictures as reference pictures to be used for decoding of a subsequent picture; and

control means which controls the reconstruction means,
wherein the control means classifies and controls each of the
20 pictures into three types:

1) a a clean random access (CRA) picture from which decoding of encoded data is started;

2) a picture, which is decoded after a CRA picture associated with the picture, and is outputted before the associated CRA picture,
25 which is not subjected to a decoding process by the reconstruction means and is not stored in the picture storage means or output, and

which has a list of reference pictures for execution of inter-frame prediction, the list of reference pictures including at least one reference picture not subjected to the decoding process by the reconstruction means, or at least one reference picture preceding the associated CRA picture in decoding order;

3) a picture which is decoded by the reconstruction means and stored in the picture storage means for reference as needed, and which is characterized in that the picture has a list of reference pictures for execution of inter-frame prediction and in that every reference picture in the list of reference pictures is decoded by the reconstruction means and is decoded after a CRA picture associated with the picture; and

wherein the reconstruction means continues a decoding process, during a period immediately before processing a next CRA picture, the decoding process continued such that when decoding of encoded data is started from an associated CRA picture, the reconstruction means determines whether every reference picture in a list of reference pictures for a target picture is stored in the picture storage means, and if every reference picture in the list of reference pictures is determined to be stored, the reconstruction means decodes the target picture, and if one or more reference pictures in the list of reference pictures are determined not to be stored, the reconstruction means skips decoding of the target picture.

CLAIMS

1. A video predictive decoding device comprising:

input means that inputs a bitstream including compressed picture data for a plurality of pictures constituting a video sequence, where each picture has a network abstraction layer unit type that identifies said picture as one of a plurality of picture types including random access picture, random access skipped (RAS) leading picture and non-RAS leading picture;

reconstruction means which decodes the compressed picture data to reconstruct pictures based on the picture types; and

output means which outputs the reconstructed pictures;

wherein

1) a random access picture is the first picture in the bitstream in decoding order when the decoding process, which starts at any random access picture in the bitstream, is started from said random access picture;

2) RAS leading picture is the picture which precedes the associated random access picture in output order, and is not decodable when the associated random access picture is the first picture in the bitstream in decoding order;

3) non-RAS leading picture is the picture which precedes the associated random access picture in output order, and is decodable,

and wherein

RAS leading picture is not output when the associated random access picture is the first picture in the bitstream in decoding order.

2. A video predictive decoding method executed by a video predictive decoding device, comprising:

an input step of inputting a bitstream including compressed picture data for a plurality of pictures constituting a video sequence, where each picture has a network abstraction layer unit type that identifies said picture as one of a plurality of picture types including random access picture, random access skipped (RAS) leading picture and non-RAS leading picture;

a reconstruction step of decoding the compressed picture data to reconstruct pictures based on the picture types; and

an output step of outputting the reconstructed pictures;

wherein

1) a random access picture is the first picture in the bitstream in decoding

order when the decoding process, which starts at any random access picture in the bitstream, is started from said random access picture;

2) RAS leading picture is the picture which precedes the associated random access picture in output order, and is not decodable when the associated random access picture is the first picture in the bitstream in decoding order;

3) non-RAS leading picture is the picture which precedes the associated random access picture in output order, and is decodable,

and wherein

RAS leading picture is not output when the associated random access picture is the first picture in the bitstream in decoding order.

3. A video predictive decoding program for letting a computer function as:

input means that inputs a bitstream including compressed picture data for a plurality of pictures constituting a video sequence, where each picture has a network abstraction layer unit type that identifies said picture as one of a plurality of picture types including random access picture, random access skipped (RAS) leading picture and non-RAS leading picture;

reconstruction means which decodes the compressed picture data to reconstruct pictures based on the picture types; and

output means which outputs the reconstructed pictures;

wherein

1) a random access picture is the first picture in the bitstream in decoding order when the decoding process, which starts at any random access picture in the bitstream, is started from said random access picture;

2) RAS leading picture is the picture which precedes the associated random access picture in output order, and is not decodable when the associated random access picture is the first picture in the bitstream in decoding order;

3) non-RAS leading picture is the picture which precedes the associated random access picture in output order, and is decodable,

and wherein

RAS leading picture is not output when the associated random access picture is the first picture in the bitstream in decoding order.